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4. TITLE AND SUBTITLE "Strontium Isotopic Composition in Arctic Pleistocene and Pliocene Marine Sediments"			5. FUNDING NUMBERS N00014-93-1141	
6. AUTHOR(S) Scott Lehman/William Curry				
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Woods Hole Oceanographic Institution Woods Hole, MA 02543			8. PERFORMING ORGANIZATION REPORT NUMBER 13114100	
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13. ABSTRACT (Maximum 200 words)  The primary goal of the research was to use $87\text{Sr}/86\text{Sr}$ as a geochronometer in Arctic Ocean sediments. This attempt was unsuccessful because the analytical precision of the analysis ( $\pm 0.000010$ ) was insufficient to differentiate the expected change in oceanic $87\text{Sr}/86\text{Sr}$ . New data published after the submission of this proposal indicated that the change was on $0.000025$ , half that of previously published data. However, a study of the strontium isotopic composition of foraminifera from the Arctic implied that there is enrichment of radiogenic strontium in the Arctic halocline. Although the mean values are statistically different in the Arctic Ocean and the South Atlantic, contamination by clay minerals in the Arctic cannot be ruled out. A simple box model indicates that some enrichment of strontium in surface waters must occur, but the amount is very sensitive to the strontium isotopic composition of Arctic rivers. Models using the most recent riverine data do not produce the observed enrichment.				
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**WOODS HOLE OCEANOGRAPHIC INSTITUTION**

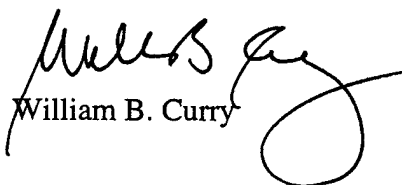
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In compliance with the reporting requirements on ONR Grant No. N00014-93-1-1141 entitled "Strontium Isotopic Composition in Arctic Pleistocene and Pliocene Marine Sediments" PI's Scott Lehman/W. B. Curry, enclosed are two copies of the report for your files.

Sincerely yours,

  
William B. Curry

WBC/amp

Enclosure

FORM A2-2  
AUGMENTATION AWARDS FOR SCIENCE & ENGINEERING RESEARCH TRAINING (AASERT)  
REPORTING FORM

The Department of Defense (DOD) requires certain information to evaluate the effectiveness of the AASERT program. By accepting this Grant Modification, which bestows the AASERT funds, the Grantee agrees to provide the information requested below to the Government's technical point of contact by each annual anniversary of the AASERT award date.

1. Grantee identification data: (R & T and Grant numbers found on Page 1 of Grant)

- a. Woods Hole Oceanographic Institution  
University Name
- b. N00014-93-1-1141 c. 4255155-01  
Grant Number R & T Number
- d. S. Lehman/W.B. Curry e. From: 9/1/95 To: 2/28/97  
P.I. Name AASERT Reporting Period

NOTE: Grant to which AASERT award is attached is referred to hereafter as "Parent Agreement."

2. Total funding of the Parent Agreement and the number of full-time equivalent graduate students (FTEGS) supported by the Parent Agreement during the 12-month period prior to the AASERT award date.

- a. Funding: \$ 144,000 N00014-92-J-1301
- b. Number FTEGS: 0

3. Total funding of the Parent Agreement and the number of FTEGS supported by the Parent Agreement during the current 12-month reporting period.

- a. Funding: \$ 0
- b. Number FTEGS: 0

4. Total AASERT funding and the number of FTEGS and undergraduate students (UGS) supported by AASERT funds during the current 12-month reporting period.

- a. Funding: \$ 59,484
- b. Number FTEGS: 1
- c. Number UGS:

VERIFICATION STATEMENT: I hereby verify that all students supported by the AASERT award are U.S. citizens.

Principal Investigator

6/27/98  
Date

## Final Report

**ONR ASSERT Award N00014-93-1-1141**

**Title: Strontium Isotope Composition of Arctic Ocean Carbonates**

**PI: Scott Lehman and William Curry**

### Students

Robert Ackert

Susan Aldermann

Michael Horowitz

Graduate education and laboratory support were supplied to three students with this ASSERT award:

1) For Robert Ackert, the primary goal of the research was to use  $^{87}\text{Sr}/^{86}\text{Sr}$  as a geochronometer in Arctic Ocean sediments. This attempt was unsuccessful because the analytical precision of the analysis ( $\pm 0.000010$ ) was insufficient to differentiate the expected change in oceanic  $^{87}\text{Sr}/^{86}\text{Sr}$ . New data published after the submission of this proposal indicated that the change was on 0.000025, half that of previously published data. However, a study of the strontium isotopic composition of foraminifera from the Arctic implied that there is enrichment of radiogenic strontium in the Arctic halocline. Although the mean values are statistically different in the Arctic Ocean and the South Atlantic, contamination by clay minerals in the Arctic cannot be ruled out. A simple box model indicates that some enrichment of strontium in surface waters must occur, but the amount is very sensitive to the strontium isotopic composition of Arctic rivers. Models using the most recent riverine data do not produce the observed enrichment.

2) For Susan Aldermann, the award provided support for stipend and laboratory analyses for her Masters Thesis in the MIT/WHOI Joint Program in Oceanography. Her thesis was on the observed changes in foraminiferal flux and isotopic composition observed in a sediment trap from the ea of Okhotsk. Her principal results show that the population of foraminiferal are calcifying in the upper 30 meters of the water column, constrained to shallow depths by the presence of the very cold dichothermal layer at about 100 meters. The coiling ratio of *N. pachyderma*, which in other locations around the world shows a change in direction at about 7 to 8 °C, is less sensitive to temperature here. In this location, left coiling *N. pachyderma* are found in waters where surface temperatures are as warm as 14 °C because they are able to find much colder water only several tens of meters below the sea surface. Inasmuch as the Sea of Okhotsk is an analogue for the glacial North Atlantic, reconstruction of past SSTs which rely on *N. pachyderma* (l) may be biased.

3) Support for Michael Horowitz was provided for a short interval during his first year in the Joint Program at a time when he was taking classes in preparation for his general examination.

## **Publications**

Ackert, R. P., Lehman, S. and Kurz, M., (1995). Evidence for heterogeneous strontium isotopic ratios in Arctic Ocean water. Fifth International Conference on Paleoceanography, Halifax, Nova Scotia.

Aldermann, S. Honjo, S. and Curry, W., (1996). Seasonal transition of species composition and isotopic variability of planktonic foraminifera in the Sea of Okhotsk. EOS, Transactions of the American Geophysical Union, v. 76, p. OS76.

Aldermann, Susan, (1996). Planktonic foraminifera in the Sea of Okhotsk: population and stable isotopic analysis from a sediment trap. MIT/WHOI Joint Program in oceanography, Masters Thesis, 99 pp.